Modeling Theory

Objectives

- Allow modeling to be done ontologically (high level of abstraction, real-world modeling, application specific)
- Then, systematically transform the application model into an efficient implementation.
  - Automatically transform the application model into a model-theoretic view of a database
  - Apply efficiency transformations (automatically, if possibly, and synergistically, when full automation is not possible)
  - Automatically generate a database scheme

Assumptions & Example

Assumptions

- no recursive relationships (add roles to remove, if necessary)
- relationship-set names include associated object-set names
- no templates (transform shorthand into underlying constructs)

Example

Generated Predicates

Object Sets

- Room(x), Room Nr(x), Cost(x), Date(x), Guest(x), Guest Nr(x), Current Guest(x), Future Guest(x), Guarantee Nr(x)

Relationship Sets

- Room(x) has Room Nr(y), Room(x) has Cost(y), Guest(x) has reservation for Room(y) on Date(z), Guest(x) has Guest Nr(y), Future Guest(x) has Guarantee Nr(y)

Generated Rules

Referential-Integrity Constraints

\(\forall x \forall y \forall z ((\text{Room}(x) \land \text{Room Nr}(y)) \land \text{Room}(x) \land \text{Room Nr}(y))\)

Generalization/Specialization Constraints

\(\forall x \forall z ((\text{Current Guest}(x) \lor \text{Future Guest}(x)) \land \text{Guest}(x))\)

Participation Constraints

\(\forall x \forall y ((\text{Room}(x) \land \exists z \text{Room}(x)) \land \text{Cost}(y))\)

Co-occurrence Constraints

\(\forall x \forall y ((\text{Guest}(x) \land \exists z \text{Guest}(x)) \land \text{Reservation}(x, y))\)

A Valid Interpretation

Object-Set Relations

<table>
<thead>
<tr>
<th>Room</th>
<th>Room Nr</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td>1</td>
<td>90</td>
</tr>
<tr>
<td>R2</td>
<td>2</td>
<td>80</td>
</tr>
</tbody>
</table>

Relationship-Set Relations

<table>
<thead>
<tr>
<th>Room has Room Nr</th>
<th>---</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1</td>
<td></td>
</tr>
<tr>
<td>R2</td>
<td>2</td>
</tr>
</tbody>
</table>

Constraints

\(\forall x ((\text{Room}(x) \land \exists y \text{Room}(x)) \land \text{Room Nr}(y))\)